STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND GAME
BUREAU OF MARINE FISHERIES

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Drift and Set Line Fishing Gear in California

By W. L. SCOFIELD

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By W. L. SCOFIELD

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INTRODUCTION

The purpose of this publication is to describe the types of multiple-ook lines (drift, set and hand lines) used in ocean fishing along the 'alifornia coast and to point out the principal variations in the gear and ts operation as commonly used by our fishermen.

We are indebted to many men in the fish trade but especially so to the lder fishermen who wore an expression of amused tolerance when first uestioned by a land lubber but ended by helping in every way possible. Ve thank you.

Most of the following pages were prepared for publication in March, 946. In most cases when earlier notes were used, the date has been indi-ated in parenthesis.

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DRIFT AND SET LINE FISHING GEAR IN CALIFORNIA

By W. L. Scofield

HOOK AND LINE FISHING

The simplest form of hook and line fishing is the "hand line" or fishing line held in the hand with a single hook or at most a half dozen hooks spaced along the far end of the line. A fishing line is more maneuverable if it is attached to the end of a pole with the pole (instead of the line) held in the hand. This is a natural development from the "hand line" and we find several forms of "pole and line" fishing in the ocean both by sportsmen and commercial fishermen. On fresh water lakes and streams the pole has evolved into a rod, bait has become an artificial fly and catching fish has become angling which many of us agree is the sport of all sports.

A preliminary step in the development of methods and gear was to move the pole back and forth so that the baited hook moved in the water simulating live bait or at least attracting the notice of the more predacious fishes. Moving the hooks in the water naturally suggested towing the

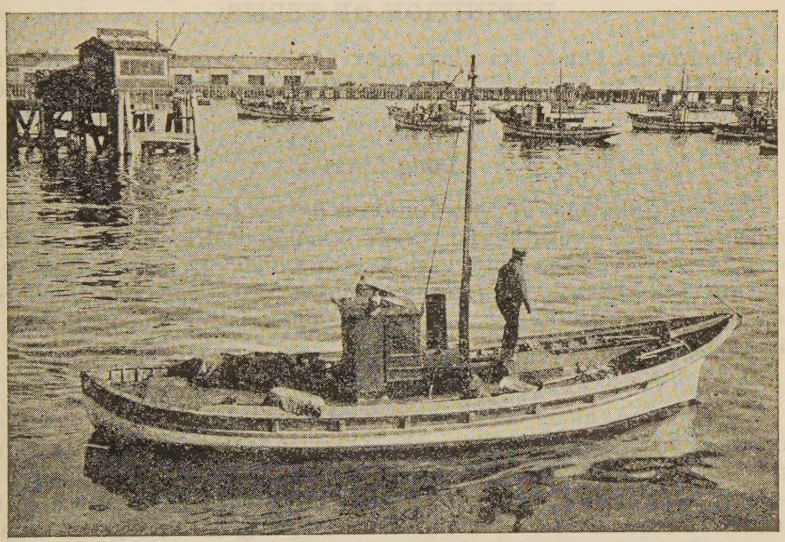

Figure 1. Monterey mackerel boat, 31 feet long. Photograph by R. S. Croker, December, 1930

line through the water from a boat that does the moving and this is "trolling." Literally to "troll" is to wander or move about, hence to angle by drawing a line and hooks through the water from a moving boat. The troll line may be held in the hand or by means of a pole or the line may be attached directly to the boat. All three variations are to be found in our sport or commercial fishing in California.

In the various forms of fishing with hand lines, pole and line, and trolling only one or two hooks are attached to any one line or if more hooks are used the number does not exceed five or six per line. The next development was a multiple-hook line but in order to use a large number of hooks the line needed to be longer and it had to be operated from a relatively fixed position. This led to the construction of the so-called "long line" which is essentially a line of great length carrying several dozen to several hundred hooks. It has evolved into several types with many variations in construction and operation. In fact, we seldom find two such lines that are just alike. It is common practice to tie two or more long lines end to end and fish them as one continuous string.

In California waters the hand line is still in use for mackerel, rockfish, flatfish, ling cod, and other species but the volume of catches by this type of gear is small. Pole and line fishing is more extensive and a considerable portion of our tuna catch is landed by a specialized method of pole fishing. Trolling, often called "jigging," is widely practiced for many species of fish but especially for albacore and salmon. Multiple-hook lines are used all along the coast for many species including rockfish, flatfish, sharks, sablefish and mackerel. Long lines are often employed to catch bait to be used in other types of fishing. The construction of the line and method of operating it is modified for each type of fishing and in lesser degree for each region of the State.

DEFINITION OF TERMS

Fishermen's names for their gear are by no means standardized but show almost as much variation as does the gear itself. Worse still one term often has several meanings.

Long Lines

The multiple-hook or long line is a device for supporting a large number of baited hooks in the water. A horizontal main line supports numerous short vertical lines, each one of which carries a baited hook. These are the essentials. The adding of buoys, floats, leads, and anchors is secondary and they are for the purpose of assisting the main line in fishing more successfully.

Main Line

The main line alone, without other attachments, is called "the line," main line, or ground line. The main line with its pendant vertical lines and hooks (with or without buoy and anchor lines) may be called a long line, trot line, drift or set line, box line, or trawl line. The use of the word trawl applied to a long line is unfortunate because trawl usually means a drag net pulled along the bottom of the ocean but the term trawl line is quite common elsewhere in the United States. The term trot line usually refers to a long line set in a lake or stream but is occasionally used by ocean fishermen.

Leader

In long lines, the short vertical branch line bearing a hook is commonly called a "gangen" from the work "ganging" meaning a special line to which a hook is "ganged" or fastened. Many fishermen call i

a leader and a few men prefer the old English names snood or snell. The name snood is sometimes corrupted into "snoot line." "Stageon" is a name used by some fishermen.

The general rule is to space the gangens a little in excess of twice the length of any one gangen so as to avoid tangling the hooks, but there are many exceptions to this rule.

Unit or Piece

A single unit of long line complete with leaders is seldom fished alone. Usually two or more units are tied end to end, and sometimes so many are fished tandem that the gear is strung out for two or three miles. The single unit is often called a "piece" or is referred to as "a line." Most frequently, however, the unit is called by the name of the container in which each piece of line is coiled. If carried in a tub, the unit is a tub of line. Thus we have a basket of line, a tray and a skate. The northern halibut men coil a unit of line on a square of tarpaulin whose appearance suggests the fish known as a skate, so each unit of long line is a skate to the fishermen.

String

The total string of line made up by tying several units end to end is most commonly called a string, a gang, or a set. It is also called a line, which is certainly not specific.

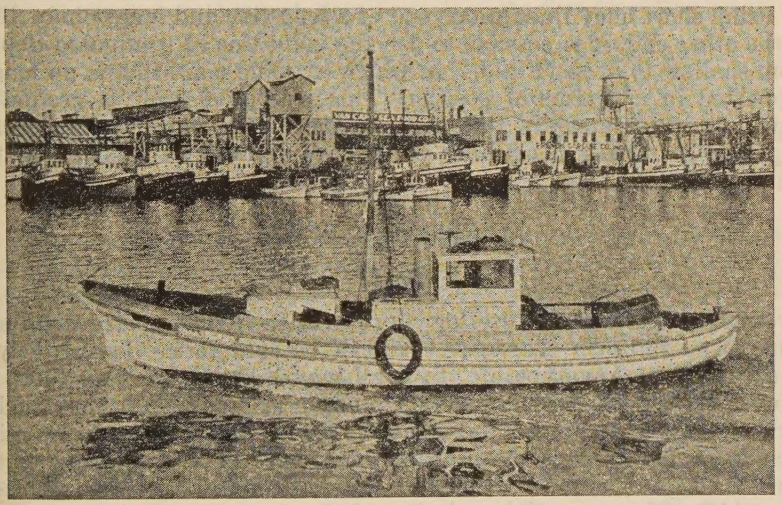

Figure 2. San Pedro mackerel boat, 33 feet long. Photograph by R. S. Croker, January, 1931

Layout and Pickup

When a string of long line is payed out into the water it is said to be laid out, set, strung, or shot. During the time that it is in the water fishing it is said to set, fish or soak.

When the line is loaded into the boat after fishing it is said to b lifted, picked up, or pulled. When it is brought to the surface to b rebaited and reset it is worked, tended, run or under run.

Drift Versus Set

Two different methods of operating have led to modifications i gear resulting in two types of long lines: Drift and set lines. As opposed to drifting, a piece of fishing gear is considered set when it is anchored or attached to the bottom or shore so that it is not free to move abou with water or wind currents. By contrast, a drift line or net has n such attachment to the bottom or shore and is therefore free to drif or move with any currents.

DEPTH

In order that the hooks of a long line may fish at a constant depth below the surface of the water, the line is supported by floats at the water surface and it usually is weighted to keep it from floating upward in water currents. Depth at which the line fishes can be determined by adjusting the length of the float or buoy lines. This is true for either drift or set lines. If the gear is to be anchored, the length of anchor line as well as length of buoy line is adjusted to the depth desired. Thus it is possible to fish the horizontal line at any chosen depth from the bottom of the sea to just under the water surface by lengthening or shortening the buoy lines (and anchor lines if anchors are used). By using short buoy lines at one end of a long line and longer buoy lines at the other end, it is possible to fish the main line at graduated depths from shallow to deep (Fig. 6), in which case the main line is no longer supported in a horizontal position. This style of fishing at graduated depths is not commonly practiced in California but it is sometimes employed in testing the fishing grounds to find out at what depth the fish are biting.

ACCESSORY GEAR

Boats

Most of the boats in use for long lining in this State are small and there is no uniform character that can be said to be distinctively a long line type. Any type of "troller" may be used for long lines. In many instances the boat is used for trolling salmon or albacore during part of the year and it may be turned to fishing traps for crabs or spiny lobsters. A few skiffs with outboard motors are in use and some of the boats with gasoline inboard engines are not much larger than decked over skiffs. However, the majority of the long line boats are diesel powered, range in length from 20 to 40 feet, and carry a crew of one or two men. Some of the larger boats have a three man crew. There is an occasional surviving 40- to 60-foot northern halibut boat (Fig. 3) engaged in long lining but nearly all boats of this type have changed to gill netting or small scale otter trawling. (1946.)

Figure 3. Northern halibut boat. Note the chute on the stern for paying out set line. Photograph by Robert D. Byers

For years past the larger boats have been equipped with a power gurdy for pulling lines or nets and within the last dozen years many of the smaller and medium sized boats have rigged some device for power pulling either their troll or long lines.

Hooks

The style of fish hook almost universally used by long liners on the California coast is the kirbed or offset hook known as Kirby (Fig. 4) and frequently referred to by the maker's name, Pfleuger. The shank is ringed and the hook is tinned. Another offset hook is the O'Shaughnessy type made in Norway by O. Mustad & Sons and often referred to as a Mustad hook. Other offset types rarely used are the Viking, Sheepshead and Virginia. Two styles, Limerick and Carlisle are straight (in one plane) and not kirbed.

Very minute fishhooks are manufactured for special purposes and hooks as small as No. 14 and No. 16 are not unusual. However, the ship chandler supplying commercial fishermen seldom carries hooks smaller than No. 12. The next larger size is No. 11 and so on by diminishing numbers and increasing size to No. 1. The next larger size is 1/0. Then 2/0 and so on up to the largest standard size which is 20/0. Ocean long liners seldom use sizes smaller than the No. 3/0 hook or larger than 16/0. Hooks made in different localities are not always of exact size and some manufacturers have other systems of designating numbers for size of hook but the numbering system as given above is standard among commercial fishermen of California.

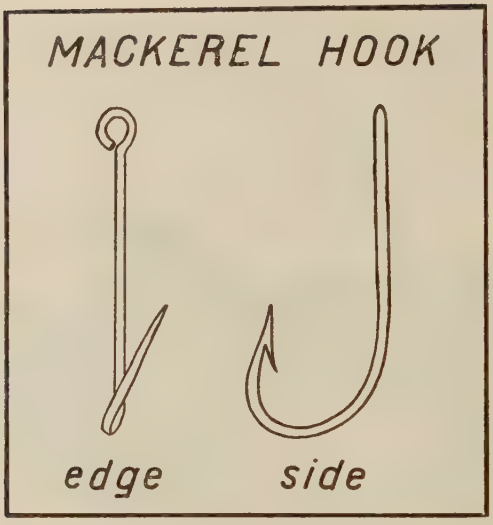

Figure 4. Typical long line mackerel hook

Twine and Rope

Lines for ocean fishing are nearly always made of cotton, but manila rope is sometimes used and sport fishermen frequently use linen. In manufacture, the cotton threads are twisted into a strand and three strands are twisted together to form the line. The degree of twist in the threads and strands determines the "hardness" of the finished line. Four degrees of hardness of "lay" are used occasionally—soft, medium, medium-hard, and hard-laid but most line fishermen prefer medium-hard laid. Gangens are frequently of hard-laid twine. The twine used in weaving the webbing for fishing nets is generally medium-laid.

Line sizes are designated by the number of cotton threads used, thus No. 60 line means 60 threads. Sizes from six to thirty-six increase in intervals of three threads, one to each of the three strands. From 42 to 60 the intervals are six or two threads to each strand. From 72 to 108 the intervals are 12 and above 108 the steps in the size increase are irregular.

During the war substitute materials were used in making rope but in normal times three strand manila rope is standard. Some fishermen prefer cotton rope for main line and even for gangens but the majority say that cotton is more apt to twist and foul the gangens. Rope sizes are in inches and fractions and are given either by diameter or circumference. On board ship circumference is generally the designation used although small rope is frequently given in diameter. Wire rope or cable is given in terms of diameter. Small rope, under two inches in circumference, increases in size steps of $\frac{1}{16}$ inch of diameter, with one additional size $\frac{5}{32}$ inch diameter. Between two and four inches of circumference the size intervals are in $\frac{1}{4}$ inches. From four to eight inches, the steps are $\frac{1}{2}$ inch. Sizes of eight inches circumference and above are in steps of one inch. Occasionally small manilla rope is designated by the number of threads in intervals of 3 from 6 to 21 threads or even up to 33 threads ($2\frac{1}{4}$-inch circumference) but this is exceptional.

TABLE 1

Manila Rope—3 Strand
Diameter and Circumference in Inches

No. of threads	*Diameter*	*Circumference*
6 fine	3/16	5/8
6	1/4	3/4
9	5/16	1
12	3/8	1 1/8
15	7/16	1 1/4
18	15/32	1 3/8
21	1/2	1 1/2
24	9/16	1 3/4
	5/8	2
	3/4	2 1/4
	13/16	2 1/2
	7/8	2 3/4
	1	3
	1 1/16	3 1/4
	1 1/8	3 1/2
	1 1/4	3 3/4
	1 5/16	4
	1 1/2	4 1/2
	1 5/8	5
	1 3/4	5 1/2
	2	6
	2 1/8	6 1/2
	2 1/4	7
	2 1/2	7 1/2
	2 5/8	8
	3	9
	3 1/4	10
	3 1/2	11
	3 3/4	12

TABLE 2

Twine Size
Expressed in Number of Threads

Intervals of 3	*Intervals of 6*	*Intervals of 12*	*Irregular*
6	42	72	198
9	48	84	210
12	54	96	216
15	60	108	234
18		120	
21		132	
24		144	
27		156	
30		168	
33			
36			

Swivel

In order to offset excessive twisting of the main line a swivel is sometimes introduced into each piece of line but in most cases this is unnecessary. More frequently it is the leader or gangen that becomes fouled by the twisting of a hooked fish and in some cases each gangen is hung from a box swivel, one eye of which has been threaded onto the main line (Fig. 5). The gangen swivel often used is size 1/0 which is large enough to thread on a No. 72 main line. The swivel may be held in place on the line by tying a stop on each side of the eye with two to four inches allowance for play of the swivel up and down the line. Three half hitches of a light line make a satisfactory stop. Fancy swivel-stop knots in the main line such as are used in trolling, are not possible with such length of line.

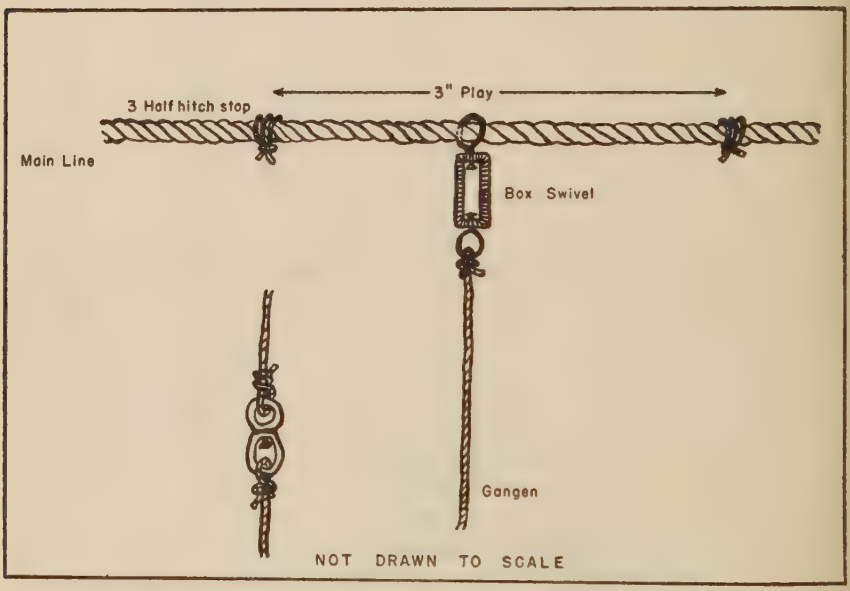

Figure 5. Gangen attached to main line by a box swivel. The swivel at the left is the type most frequently used in the main line or in anchor and buoy lines

Floats

In order to hold one end of a buoy or anchor line at the water surface it must be made fast to a float, the most commonly used form being a wooden keg, usually brightly painted to increase visability. Each end of a string of long line is usually marked by such a keg. The point of union of any two pieces of long line (especially drift line) usually is designated by a keg. If a piece of long line needs to be buoyed at other points than the two ends, it is floated by a small keg, a bundle of corks lashed together, a large square of block cork, a rubber or canvass ball or a piece of oiled wood at the water surface. Wooden floats do not have the buoyancy of kegs but are sometimes preferred because they take up less space on board a small fishing boat. Under-surface floats seldom are used in California line fishing. (Fig. 16.)

Markers

Even a gaily painted keg in a choppy sea is not easily seen at a distance so flag markers have been added. Occasionally a light pole bearing a flag is lashed to a keg but the usual form is a separate pole "marker." A bamboo pole 10 or 12 feet long is floated at a point a little over one third of the way up from its base by a bundle of corks lashed at that point. A piece of lead, scrap iron, or a window weight lashed at the base of the pole serves to keep it upright in the water. A square of brightly colored cloth at the tip of the pole makes a flag that can be seen from a distance. This pole marker is attached to a keg float by a couple of fathoms of light rope. (Fig. 11.)

Anchors

In years past the long line fishermen used, as a weight, a water worn rock preferably elongated in shape so that it readily could be made fast to a line. The smooth rock offered no cutting edges and it was cheap. Now-a-days the rock has been supplanted by a window weight which also is smooth although not so cheap but it has an eye through which a line can be threaded and, for a given weight, it is small and conveniently stowed.

In situations where set lines might be drifted by strong water currents the two ends of a string of lines are anchored with a conventional small-boat sand or kedge anchor, often of five pounds weight. Five pronged grapnel anchors are common and sometimes a mushroom anchor is used. Occasionally anchors are placed at the union points where two pieces of ground line join but this seldom is necessary.

Buoy and Anchor Lines

When the fishing gear is coiled on the deck of a small boat the buoy and anchor lines require a good deal of space. Especially when the gear is hand operated, the setting and lifting of anchors and buoys is a heavy task. For these reasons, the lighter the rope the better. Heavier gear is required in areas of strong currents but under average conditions the size of rope most frequently used is $\frac{1}{2}$ inch diameter ($1\frac{1}{2}$" circonference) or $\frac{5}{8}$ inch diameter (2" circumference).

The depth below the water surface at which a drift line will fish is determined by adjusting the length of the buoy lines and in this case the buoy lines are nearly vertical in the water. (Fig. 6.) The same may be true of shallow fishing set lines (Fig. 11) but when the set line is anchored close to the bottom the buoy lines serve in marking the location of the gear and are the means of lifting it to the surface. In this case the buoy lines must allow some play of the float at the water surface and must be from $\frac{1}{4}$ to $\frac{1}{2}$ longer than the depth of the water being fished. More play is required in deeper water or when heavy water currents or high winds are encountered. At moderate depths buoy lines may be given an extra 25 fathoms of length. Thus 80 fm. of line may be used in depths of 40 to 60 fm. At the depth of 200 fm. the float lines may be 250 fm. long or even 300 fm. in case of very strong currents.

DRIFT LINES

Simple Drift Line Operation

A simple form of long line is the drift line fished close to the surface of the water which means that buoy lines are short and there are no anchor lines. The simple gear is cheaper to build and maintain and it is easily operated by one man alone. Surface or shallow fishing is usually close to shore so that a small motor boat or skiff with outboard motor or even a rowboat is sufficient, thus avoiding a heavy boat investment. Consequently we find a number of men fishing alone from a skiff or small boat fairly close to shore in comparatively shallow water, catching bait, rockfish or mackerel in small amounts but appreciating the ratio of return per unit investment. Units of gear are added as the pocketbook allows till the enterprise justifies a boat capable of working farther from port in deeper water and the increased amount of gear calls for a helper fishing on shares. A number of our prosperous fishermen started on a small scale fishing drift lines.

In general, the drift line fishermen of our coast work from small boats with a one- or two-man crew and pull their lines by hand (1946). Unanchored drifting lines are seldom, if ever, left set over night for fear of loss. The boat usually is employed in lifting lines to rebait the hooks and in removing the catch. Thus the lines are worked almost continuously, in contrast to set lines which are left out for a considerable time interval before lifting. Danger of losing the gear and continuous working of the lines are a limitation upon the amount of gear laid out so that generally the drift line fishermen set out fewer units of line than is the common practice among set line fishermen.

Mackerel Fishery at San Pedro

Along the southern half of the California coast mackerel are found abundantly close to shore at moderate depths and these are the conditions that encourage a small boat fishery. Under Spanish rule there was hand line fishing for mackerel and later a small scale drift line fishery supplied the limited demand of the fresh fish markets at the principal ports from Monterey southward.

Probably the most extensive drift line fishing along our coast was developed in the San Pedro area where a fleet of about 20 small boats supplied mackerel to the fresh fish markets. Beginning about 1928 mackerel canning created a market for increased catches and drift line fishing had a boom for a period until dip netting or "scooping" for mackerel was developed. There were portions of the year when purse seiners did not do well at catching mackerel or when these boats were engaged in sardine fishing so that line caught mackerel were in great demand at the canneries.

Drift Line Gear at San Pedro

The drift line gear and fishing operations for mackerel at San Pedro (as of 1931) were described in detail by Croker (1933, pp. 45-50) and the following is based upon his description.

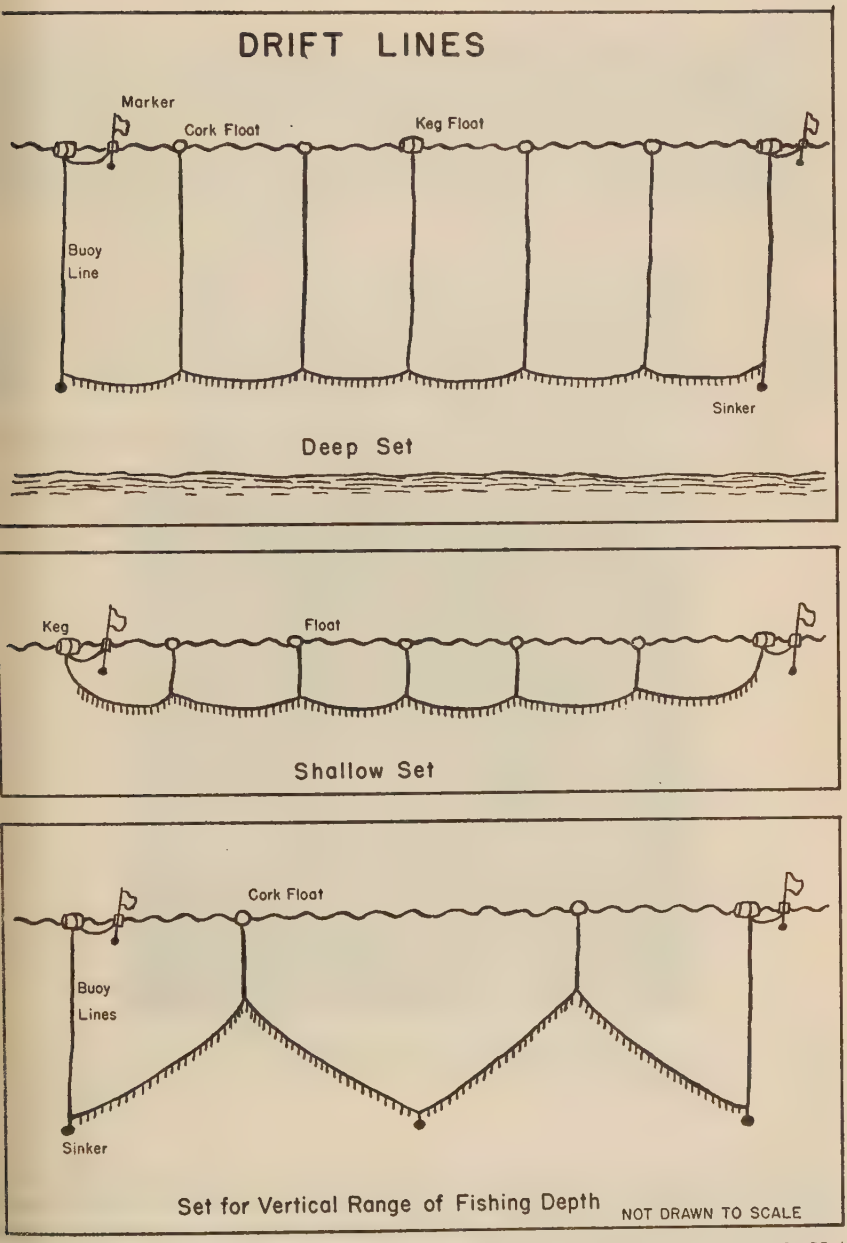

Figure 6. Drift lines set deep, shallow and for a vertical range of fishing depth. Not drawn to scale

Boats

Most of the boats used were 25- to 35-foot trollers of the clipper bowed "Monterey type," with a one-man crew fishing within one or two miles of shore not far from the port of San Pedro. Most of these boats were powered with a one-cylinder gas engine. Handling of lines was manual without the assistance of a power gurdy. Trips usually were only a half day out of port. The catch of mackerel and horse mackerel was carried in fish boxes on deck, usually without ice.

Lines

Main lines were made up from No. 60, 72, or 84 tanned medium hard-laid cotton line, 1250 feet or more in length. Each piece carried 400 to 500 hooks. Snods or gangens of No. 12 or 15 hard-laid cotton were 18 inches long spaced 2½ to 3 feet apart. Tinned hooks were No. 4/0 or 5/0 in size.

Lines were coiled in shallow wooden boxes or trays with one side open and the hooks were arranged to face the open side.

Figure 7. San Pedro mackerel drift line coiled in tray ready for fishing. The baited hooks are covered with salt which preserves the bait. Photograph by R. S. Croker, October, 1931.

Gang

In many cases the gang or string was made up of two pieces but if fish were scarce there might be three or four pieces to the gang. Sometimes two gangs with two or three pieces each were fished, especially by the occasional boat with a two-man crew. The amount of gear laid out was limited by the market demand for the catch and also by the fact that the lines were constantly worked and were not left unattended for very long at a time. It required about an hour to set or lift a gang of two pieces so that the boat usually returned to the initial end of the line and started lifting as soon as the last gang anchor was set out.

In laying out a gang of line an anchor and a keg buoy with flag marker were set at each end of the gang. A keg buoy without flag was placed at the point of union of any two pieces. Large corks serving as floats or bunches of corks as a buoy were attached at one-third and at two-thirds of the length of each piece of line. Thus a two-piece gang would be set with two anchors, two flag markers, three keg buoys and four cork floats. (Fig. 6.)

Figure 8. Hauling in mackerel drift line by hand. Photograph by R. S. Croker, off San Pedro, October, 1931.

Gangs were set parallel to the shore in order to reduce the chance of having the lines fouled by boats traveling up and down the coast.

Depth

The depth at which the gear fished could be altered quickly and easily by adjusting the length of the buoy lines and changes in depth were frequent till the fish were located. Occasionally buoy lines were adjusted at different lengths so that portions of the main line were diagonal to the water surface instead of horizontal in order to get a vertical range or variation in depth at which the hooks fished.

Mackerel were found deeper in the winter months and closer to the surface during warm weather. In addition there was variation with locality but the average range in depth at which the gear fished was 30 to 75 feet or 5 to 12½ fathoms.

Figure 9. San Diego mackerel fisherman re-coiling his line while waiting to unload. Photograph by D. H. Fry, Jr., December, 1930

Bait

The favorite bait for the hooks was fresh mackerel cut into small chunks. Whole anchovies or small sardines in a fresh state were used also. On the return trip from the fishing grounds the fishermen cut bait for the following day but untangling the lines, recoiling, and rebaiting the hooks for the next day was a job requiring several hours and this was done ashore in the late afternoon after disposing of the catch.

DROP LINES

Development

The simplest form of set line used in California is the so-called drop line which is not properly speaking a long line in that the line is not very long and its length is fixed and not capable of being increased by the adding of other units. It was, up to a dozen or so years ago, operated as a hand line but has evolved into a simplified set line. (Fig. 10.)

Originally it was a hand line used chiefly in the southern half of the State for catching rockfish and flatfish on or near the bottom. The hand line with a half dozen hooks and light terminal sinker was modified by adding more hooks and a heavy rock for a sinker. This line was known locally as a "hand line," "up and down line" or "drop line." One, or in some cases two such drop lines were cast out from the boat and the line made fast on board. Enough line was payed out so that considerable slack allowed the line to curve up to the boat on such a diagonal from the vertical that most of the hooks could fish close to the bottom. From year to year the line was lengthened and more hooks and gangens added but multiplying the number of hooks resulted in too many of the hooks fishing too far from the bottom. To further increase

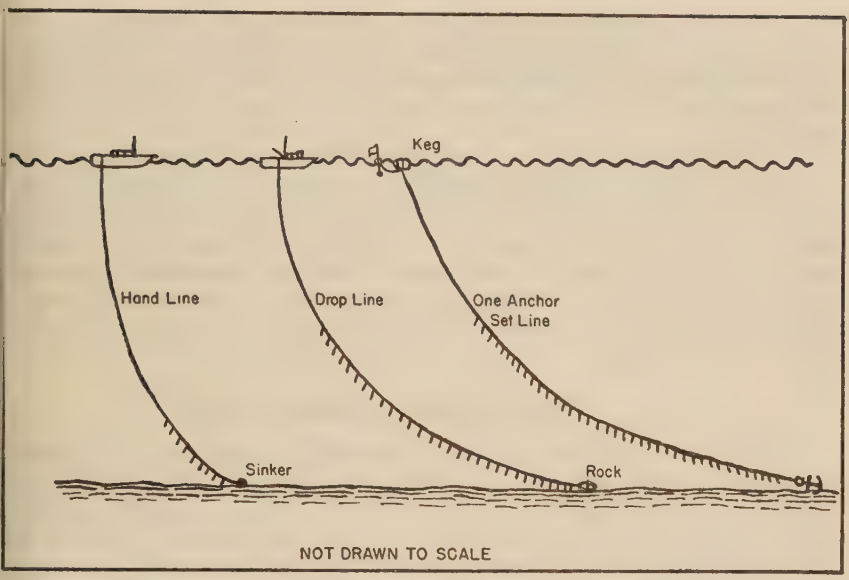

Figure 10. Evolution of the one anchor set line from the hand line and drop line

the number of hooks operated, it was necessary to fish more than two lines and this was done by attaching the free end of each line to a buoy instead of making it fast to the boat. The boat then could cruise from one buoy to another and pick up the lines in rotation. Of course this required adding a flag marker so that the buoy could be located readily. Since a line no longer served as an anchor to the boat but merely had its upper end buoyed at the surface it was possible to replace the heavy rock sinker with a window weight to serve as anchor. Thus the gear had evolved into a diagonal set line. It is still called locally a drop line or more properly "single anchor line."

For Rockfish at Santa Cruz

On the north side of Monterey Bay at the port of Santa Cruz a group of a dozen or so men fishing for rockfish continue to use hand lines called locally "up and down lines." In each case one man fishes alone from a small boat and sets only one line with one anchor in 60 to 100 fm. of water. Lines are pulled by hand as these small boats are not equipped with a power gurdy. No buoy or marker is used as the line is held in the hand or made fast in the boat. The usual practice is to hold the line in the hand until the tug of hooked fish indicates that the line may be lifted. In any case the time of "soak" is not more than a half hour because of the abundance of hag fish which attack the hooked fish. The line is usually of 144-thread soft-laid cotton with 170 to 200 hooks. Short leaders are characteristic of rockfish set lines along the California coast, and at Santa Cruz the 33-thread "snoods" often are cut in 14-inch lengths but when the ties to the main line and to the shank of the hook are made, the leader is only about eight inches

long. Some fishermen cut leaders in 18-inch lengths making the tied snoods about 12 inches long. Spacing between leaders is 18 to 20 inches. When stowing in a basket the mainline is coiled with short turns in the center while the snoods are not looped but run straight to the basket edge.

The hand line is frequently divided into two halves so that only one-half of the line may be used when fishing rocky bottom or in a confined shallow area. In this case the half line carries 80 to 100 hooks but there is no other change in weight of line, length of snoods or spacing between hooks. The two parts of the line are coiled in the same basket. At Santa Cruz, unfortunately, the term "trawl" is applied to a basket of line. When one-half of a divided line is referred to, it is called a "short trawl."

For Rockfish at Monterey

Drop line fishermen fishing for rockfish at Monterey, as at Santa Cruz, prefer to use more hooks than are used on similar gear in Southern California. At Monterey the drop lines may carry as many as 150 to 200 hooks on 16- to 18-inch gangens set only about 18 to 24 inches apart. Window weight anchors are common and the buoy has a flag as marker. Usually only two or three such lines are fished at any one time. The lines are worked continuously as hagfish are abundant and a hooked fish cannot be left very long without being attacked. Monterey fishermen prefer setting few lines but each carrying many hooks.

For Rockfish at San Pedro

San Pedro fishermen employing drop lines for rockfish use only about 25 hooks to the line but commonly fish four or five lines. The usual window weight anchor and flagged buoy are standard. Continuously lifting and rebaiting five drop lines is sufficient to keep a two-man crew of a boat busy while the gear is set.

For Rockfish at Newport

Newport rockfish drop liners use 75 to 200 hooks per line and set two or three lines at a time, which is similar to operations at Monterey but with fewer hooks as an average. Again window weights are accepted anchor substitutes and buoys are flagged.

PACIFIC NORTHWEST HALIBUT LONG LINES

Probably the first extensive set line fishing on the Pacific Coast, ; least the best known set line fishery, was the long lining for halibut ıt of Seattle, Prince Rupert and Ketchikan. It is natural that the ear used for northwest halibut should be accepted as the standard om which variations in gear may be measured and it is for this reason hat we give a brief summary of the halibut gear as described by hompson, Dunlap and Bell (1931).

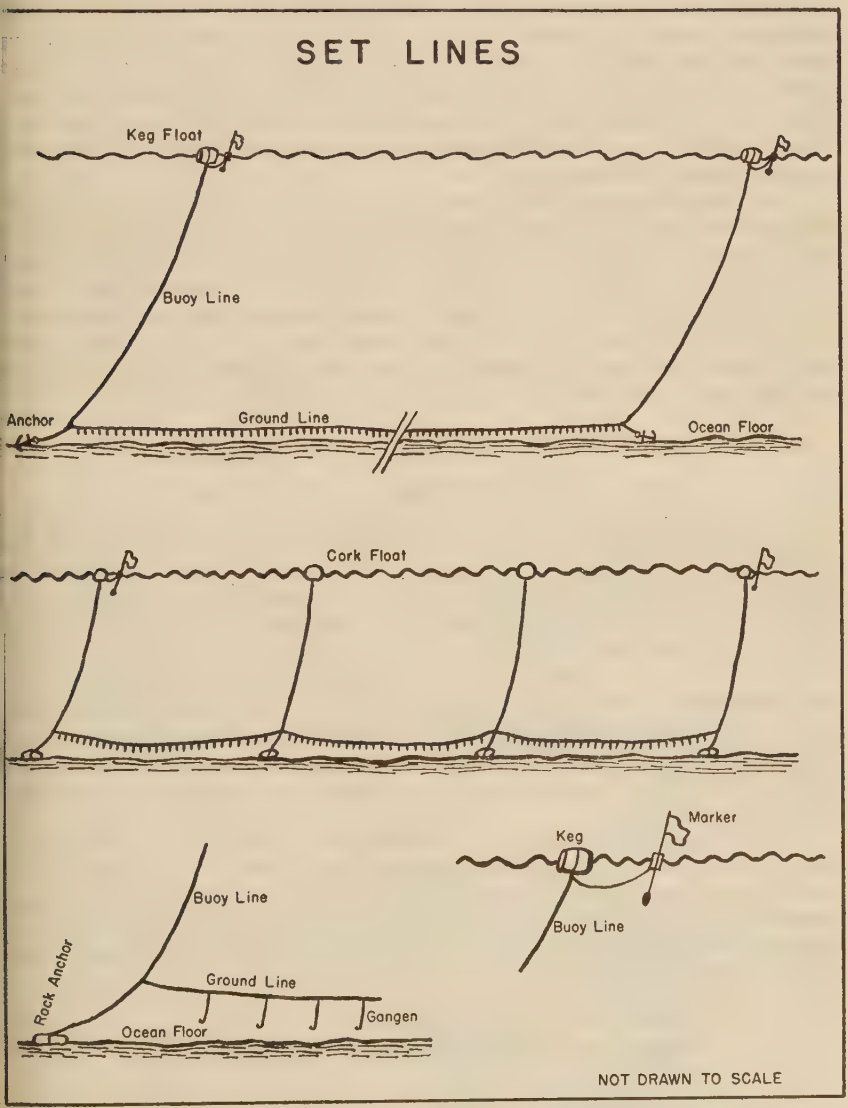

Figure 11. Illustrating two of the many forms of set lines. Not drawn to scale

A heavy "ground line" of No. 32 to 48 hemp was made up by splicing about six 50-fathom sections (called "lines") together to form a unit 300 to 350 fm. long called a "skate." Two to 20 skates were tied end to end in a "string." A 25 pound anchor held each end of the string but sometimes additional anchors were used on very long strings. Each end of the string carried a keg buoy with a bamboo pole and flag as a marker. The buoy carried a light at night. The buoy line was 25 to 50 fm. longer than the sounding at that spot. Depths fished varied from 15 to 500 fm. but usually they were 45 to 150 fm.

The gear was modified according to which of the two types of fishing was intended. A dory vessel carried 10 or 12 nested dories which were put over the side with two men per dory and two to six skates of line, and usually two sets per day were made. Because of this arrangement with two dory men, one hauling and one coiling or baiting, it was convenient to have the gangings spaced nine feet apart. The cotton gangings were five feet long.

In the other type of operation the gear was handled from the deck of the vessel and the ground line was hauled by power so that a wider spacing of 13 instead of nine feet between gangings allowed more time for coiling. The vessel would set four to 20 skates instead of two to six skates from each dory. Such a vessel carried less men than a dory vessel and fished less gear than the sum of all dories of the dory vessel but it fished more gear per man, the gear was handled more continuously and the operations were more convenient and safer.

SABLEFISH SET LINING AT EUREKA

History

For many years past a set line fishery for halibut and sablefish has flourished in the area from Crescent City to Fort Bragg, centering at Eureka with its railway outlet to markets. Up to 15 or 20 years ago the lines used were the heavy halibut gear such as are used in the Seattle area. Lines were coiled down on "skates" of tarpaulin as in the north. Since then the trend has been toward lighter gear and gradually lines were shortened into convenient lengths for coiling in wicker baskets. Gangen length was reduced and the spacing between hooks was shortened. Beginning about 1932 or 1933 the set lines were made still lighter and were coiled into wooden tubs. The so-called tub gear is still in favor with many fishermen.

The Noyo (Fort Bragg) fishermen are credited with developing still lighter and shorter lines called locally "fine lines," with small hooks closely spaced on shorter and lighter gangens. This gear was introduced into Eureka about 1944 and is now (1945) favored by 30 to 40 percent of the Eureka fishermen. Thus there have been four steps from heavy to lighter gear.

1. Halibut gear in skates.
2. Lighter gear in baskets.
3. Tub gear.
4. "Fine lines" in baskets.

he tub gear and the basket fine lines are now (1945) commonly in se in the Eureka area.

The old style skate gear was developed in the north for halibut shing from medium sized boats with a crew of several men. Along the orthwest coast of California the crew of two or three men in a small oat naturally preferred gear that could be more easily handled and ne steady trend has been toward lighter lines for a one- or two-man rew. Also the trend in Northern California has been away from halibut nd toward fishing primarily for sablefish with halibut caught only ncidentally. This type of fishing permits use of lighter gear. The halibut eason was closed by the International Fisheries Commission when ne area catch quota was reached and California fishermen complained nat the halibut quota was caught farther north in the early part of ne open season resulting in a light catch and a short season in this State. Consequently our set liners were more and more dependent upon a ablefish catch for their existence. This was true until the shark fishing onanza attracted all available set liners but soon the expensive but successful gill netting of sharks at least partially crowded out the long iners. Now (1945) that the shark gold rush seems to be over the set iners are dependent more than ever upon sablefish and they often find t necessary to fall from grace and supplement their income by trolling or salmon during the summer season. This in spite of the high fish prices during the war years, augmented by the sale of sablefish livers for their vitamin content.

Boat Trips

The number of boats in the Eureka set line fishery fluctuates through he season with the diverting of men to other types of fishing and the nflux of long liners from other ports, especially Fort Bragg, but the low point of the year is through the late summer salmon trolling season. About 20 boats at Eureka and a similar number at Fort Bragg can be considered consistant long liners. One- and two-man crews predominate with a few larger boats carrying three men. Nearly all boats are equipped with a power gurdy for pulling lines.

During parts of the year the boat trips are only one day out of port but through most of the year the trips are of three to five days duration with some seven-day trips. Fish are usually cleaned at sea and stowed in chipped ice and seven days are about the limit for keeping fish in good condition in the iced hold.

Currents

The northern coast of California is subject not only to rougher seas than in the south but also to stronger currents. Eureka fishermen therefore use heavier anchors and longer buoy lines. They usually set their lines a little on a diagonal to the current rather than with it as they find the lines so set are less apt to foul. In spite of the currents, a string of lines is seldom set with more than two anchors, one at each end and leads or other weights are not used. Lines are set in water from 70 to 350 fathoms deep but most of the fishing is done at 80 to 200 fm. Fishermen say that sablefish are in deeper water in the winter and as the

season progresses they come closer inshore so that Eureka men start the season at about 220 fm. and by the end of the season are fishing at 80 to 100 fm. At Fort Bragg early season fishing is often at 300 fm. or more and later in the year is at 200 to 220 fm.

Fishing Time

The length of time the lines are "soaked," that is, left set and fishing, is determined primarily by the activity of hagfish ("slime eels" or "slimeys") in the area. Usually in the Eureka area when lines are in the water four or five hours it is found that most of the bait has been stolen from the hooks and the hooked catch has been attacked by hagfish. If gear is soaked only one hour there is a serious limitation to the amount of gear that can be set and lifted in that time interval. The best compromise has been found to be 1½ to 3 hours fishing time for set lines. This means that one man alone is definitely limited as to the amount of gear he can run. A two- or three-man crew can naturally handle more gear in a limited time, which is advantageous provided the resulting catch is two or three times greater than for a man fishing alone.

Size of Fish

The chief market outlet for sablefish is as smoked black cod and for smoking purposes the larger fish are preferred. In years past the market buyers demanded fish five pounds and over because smaller fish were thought to be softer and would not sell so well for smoking. During the war years four-pound fish and smaller were accepted and such large numbers of small fish were delivered that the long line fishermen became alarmed and voluntarily adopted a four pound or 34 inch minimum size limit. The relative abundance of small fish has been one reason for the development of light basket gear with its large number of small hooks. Heavier gear is credited with catching larger fish consistently.

Bait

Some fishermen catch sardines, herring, anchovies and smelt for bait but the majority use scrap fish obtained from the fresh fish markets as well as odd species caught on their own lines. Small flatfish discarded by trawlers are in demand as bait and at times it has been necessary to ship frozen bait from San Francisco to Eureka. Almost any kind of fish material will do for sablefish bait but halibut are much more particular.

Tub Versus Basket Gear

The type of container is of little importance but the construction of the gear and methods of operating it differ considerably in the two types of set lines now in use along our north coast. The tub is a straight sided wooden container about two feet in diameter and one and one-half to two feet high with a frayed rope or cork margin around the lip of the tub into which the hooks may be set. The wicker baskets, about 2½ feet in diameter, are very shallow, little more than flat, with a soft rope rim for hook setting.

The older tub type of line is longer, heavier, has fewer and larger ›ks, has longer gangens spaced farther apart, and the lines are neatly led as brought in with gangens cleared and hooks set in the rim of e tub ready for baiting. The heavier gear does not tangle so badly as do e lighter lines. Hooked sablefish are given to winding the gangens ›und the main line. In the newer lighter basket type of gear the lines ually are coiled hastily in the basket without untangling gangens or ting the hooks. The lines must therefore be recoiled, cleared and oks set as another operation before baiting. Basket gear is usually ared and coiled in port after the day's fishing, and baiting is usually ne in port. Tub fishermen bait up on the trip out and have no recoiling to do after the lines are lifted, although coiling and setting hooks the gurdy-pulled line comes aboard requires fast work. The chief fference in the two types of fishing is therefore that basket gear has a eatly increased number of hooks in the water during fishing time d all else is subordinated to this. The basket gear requires long hours port recoiling line and baiting hooks. The basket carries more hooks, ore units of line are set at a time and more work is required in tangling the fouled line of the lighter gear so that on one-day trips ere frequently is not time for the crew to clean fish. Consequently e catch is often delivered in the round when the boat is in late, whereas b fishermen have the time during the return to port in which to clean e day's catch. The price differential of cleaned over round fish is substantial, especially during the war years when the man power shortage ft few fish cleaners in the markets ashore and quite generally price remiums were offered fishermen to clean at sea.

Tub Gear

The heavier tub gear, harking back to halibut fishing days, uses as andard a $\frac{3}{16}$ inch diameter manila rope as main line. Lines are 230 to 50 fm. long with gangens 9 to 12 feet apart. Gangens are $2\frac{1}{2}$ to 3 feet ›ng of hard laid 48 to 72 thread twine. Large hooks, sized No. 10/0 r 11/0 are commonly used and there are 100 to 135 hooks per tub ith 130 as standard. It is the general rule of tub fishermen to set four ›bs of line in a string and to lay out two strings. This means eight tubs f line out of about $2\frac{1}{3}$ miles of line. It requires $1\frac{1}{2}$ to 2 hours for two ›en to lift four tubs of lines. Eight tubs are the usual amount of gear or a two-man small boat and three or four sets of the gear are made uring the day, which requires almost continuous working of the lines. three-man crew may lay out five or six tubs to a string.

Basket Gear

The main line of basket gear is usually 198-thread hard laid twine bout 100 to 110 fm. long with gangens generally three feet apart, in ontrast to the wider spacing of tub gear. Gangens are usually 22 inches ong of hard laid 36 thread twine. Short gangens are almost necessary or coiling line in shallow baskets. Small sized (No. 6/0) hooks are tandard for sablefish but No. 10/0 hooks are used if many halibut are xpected. There are generally 200 hooks per basket of line contrasted with 130 hooks per tub. Fifteen to 25 baskets of line are laid out with 20 baskets the general rule. Twenty baskets, carrying 4,000 hooks would

total about 2½ miles of line out at one setting. This would mean that four times as many hooks were fishing as with the comparable eight pieces of tub gear with their 1,000 hooks and lines totaling 2⅓ miles. Crews fishing basket gear are from one to four men but three men to a boat is common. In this case one man works the lines as they come in, another recoils and sets hooks while the third rebaits other baskets of line ready for laying out. Setting the light gear can be done rapidly.

SABLEFISH AND ROCKFISH SET LINING AT SANTA CRUZ

Depth

By the summer of 1945 set lining for sharks at Santa Cruz had ceased to yield an adequate return and fishermen had resumed their quest of sablefish and rockfish, commonly called black cod and rock cod respectively, although they are not cods. Sablefish are found at greater depths than the rockfishes and consequently heavier set lines are used. Some species of rockfishes may be found in deep water but most of them are caught at moderate depths and lighter weight set lines are used with shorter leaders and hooks set closer together. The heavier sablefish gear is occasionally used for rockfish but generally the lighter weight set lines are preferred.

In general, sablefish set lining is at greater depths than in any other California fishery. During the summer months at Santa Cruz the set lines usually were fished at 60 to 80 fm. and down to 150 fm. In the winter months the lines were set often at 150 fm. and even as deep as 200 fm. At Santa Cruz the rockfish lines commonly were set at 45 to 50 fm., or less than half the depth of the sets for sablefish.

Boats

In August of 1945 about 12 Santa Cruz boats were fishing set lines and an equal number were hand lining for rockfish. Boats fishing for sablefish commonly had crews of two men although larger boats carried three and occasionally up to five men. Smaller boats fished rockfish with a one-man crew. These were usually the so-called "Monterey type" boats with clipper bow and crowned deck originally designed for lateen sailing. All the sablefish boats were equipped with power gurdy for pulling lines whereas few of the rockfish boats were so equipped. Most of the larger boats trolled for salmon and albacore during favorable parts of the season and used set lines for the remainder of the year. Other boats set lined sablefish the year round.

Trips

Standard practice at Santa Cruz (1945) was to make only one-day trips, starting before daylight and returning in the early afternoon. This meant that grounds fairly close to the port of Santa Cruz were the only ones fished. The occasional trip to more distant grounds required two days and the catch seldom doubled that of a local trip. None of the boats carried ice and all fish were delivered in the round with no cleaning at sea. One set per day was made and the layout of lines was little influenced by the moderate currents of the northern portion of Monterey Bay.

Figure 12. Rockfish set line boat with baskets of coiled line. Meigs Wharf, San Francisco, May, 1934. Photograph by H. B. Nidever

Coiling Lines

Among Santa Cruz fishermen the common practice was to coil their lines roughly when pulled without setting the hooks. On the trip back to port all the gear was recoiled and the hooks set. After the catch had been delivered, the lines were then baited in the late afternoon or evening in readiness for the following day. The baited hooks were not reset but were left hanging over the edge of the basket.

Sablefish Lines

As ocean currents do not seem to be bad in the Santa Cruz area the lines were set with an anchor, buoy and marker only at each end of the string, and with no supplemental anchors or buoys. The anchor used most was an eight- or nine-pound window weight, a device that would not secure the lines on many parts of our coast. The buoy lines usually were $\frac{5}{8}$ or $\frac{3}{4}$ inch (circumference) hard laid cotton, possibly because of the difficulty in obtaining manila line at that time.

The main line was heavy, being either 216 or 234 thread hard-laid and usually 600 to 700 feet long. The gangens, locally called snoods, varied from 30 to 38 inches but were commonly 36 inches long and when made fast to the ground line resulted in a leader about 33 inches long. Snoods were of 36 to 42 thread hard-laid. They were spaced 28, 36 or 40 inches apart so that a basket of main line carried 200 to 225 hooks, the latter being standard. Swivels were not used either in the main line or in the attachment of snoods.

Commonly a two-man crew set 10 to 12 baskets of line in a string, equivalent to a line about $1\frac{1}{3}$ miles long. Sometimes a larger crew would set up to 22 baskets or $2\frac{1}{2}$ miles of line. One man fishing alone usually set four baskets. The factor limiting the amount of line set at one time seems to have been the time required to pull and roughly coil the line

at pickup time. To pull and coil 12 baskets of line required 2 to 3¼ hours and with more than 12 baskets a crew might require four hours for the pickup. The time consumed in pickup influenced the length of time the line fished. The "soak" or fishing time was 1¼ to 1½ hours.

Figure 13. Unloading a mixed catch of mackerel and rockfish at Monterey. Photograph by R. S. Croker, December, 1930

Lines were coiled in circular wicker baskets about two feet two inches in diameter and five inches deep with a rim of matting for setting the hooks. Some were of metal with a soft rubber rim for the hooks. The basket and therefore the single unit of set line was locally caled a "trawl," which is a misuse of the term.

Most of the bait used was salted sardines, each fish cut into two to four chunks. Some whole anchovies were used and at times cut squid was resorted to.

Nearly all the Santa Cruz fishermen were using a 6/0 Pfleuger hook. A few used the 7/0 size. Although their hooks frequently were used for two years, most fishermen preferred to start each season with new hooks. Several men expressed a preference for the Norway Mustad hook which was credited with being good for 8 to 12 years' service but such hooks were not available in 1945.

Rockfish Lines

At Santa Cruz in 1945 most of the rockfish fishing was conducted by small boats with a one-man crew using either set lines or hand lines. In either case one-day trips were made to nearby grounds. The lighter rock cod set lines were fished at 45 to 50 fm. and one man alone seldom set more than three or four baskets of line running 60 to 80 fm. of ground line to the basket. Lines were pulled by hand even when the boat was

equipped with a gurdy as it was claimed that one man alone could not power-pull lines and coil into baskets at the same time.

The light set lines were made up with an 82-thread main line and 24-thread leaders or snoods usually two feet long spaced a couple of inches less than two feet apart. This spacing would run about 200 hooks to the basket of main line, which was the standard number of hooks. Sometimes rockfish lines, intended for shallow water fishing, were made up with snoods as short as 12 inches spaced 14 inches apart.

Figure 14. Rockfish being hauled in from a depth of 100 fm., off Point Sur (Monterey County). Photograph by J. B. Phillips, April, 1938

ROCKFISH SET LINING AT MONTEREY

At Monterey (in 1942) rockfish set lines usually were coiled in baskets with 300 to 900 feet (50-150 fm.), but with 600 feet (100 fm.) as the most common length, of ground line. Gangens were 12 to 30 inches long and spaced 24 to 36 inches apart. Two feet was the usual spacing between leaders. The number of hooks per basket of line varied from 125 to 360 depending upon the length of main line and spacing of leaders but 300 hooks spaced two feet apart on a 100 fm. main line was the usual plan of construction. One fisherman alone would set three or four baskets of line, but frequently a two-man crew would set eight baskets. An occasional three-man crew would handle an average of 11 baskets, which was equivalent to more than 1½ miles of ground line. Normally only one set per day was made as it required two or three hours to lift the lines after they were set. Lines were pulled by hand. The "soak" could not be much over three hours because of the depredations of hagfish and a 1½ to 2 hour set was preferable. Sets were made at depths of 50 to 120 fathoms but occasionally at 150 fm.

Figure 15. "Baiting up" and re-coiling rockfish set lines at Monterey. Photograph b J. B. Phillips, April, 1938

SHARK SET LINING AT NEWPORT

Lines Versus Nets

For several years many boats out of Newport (Orange County attracted by high prices, had turned to set lining for sharks. In th late summer of 1940 one Santa Barbara shark boat fished gill nets a Newport and did so well that local fishermen planned to acquire ne when money and materials were available and all agreed that set lin would be outmoded. However, shark set lining continued and the followin account of the fishery is from notes made in October 1941. At that tim no local gill nets were being fished at Newport although net purchas had been made. Old time line men hoped to continue shark fishing i deep water even after gill nets had taken over shoal water operation At that time gill netters had not used glass ball floats and corks woul not resist the pressure of water deeper than 20 fm. Within a few month gill net fishermen had discovered that glass floats would enable the to fish at any depth desired.

Areas Fished

In 1941 Newport long line boats were fishing heavily the are from La Jolla to San Pedro and made occasional trips to Santa Cru Island. Many of the boats took ice for four- and five-day trips. Mo boats were equipped with a power gurdy for pulling lines. Most of t fishing was at 35 to 70 fm. although a few small boats fished in ve shoal water of 5 or 10 fm. and some gear fished as deep as 200 fm.

Duration of Set

In these waters, free from hagfish, the lines could be left set for ong periods. Most fishermen set their lines in the early morning and ulled them four or five hours later. A few men left their gear set all lay and pulled in the evening. One man left his lines for two weeks at a ime but lifted every morning for baiting and removing the catch.

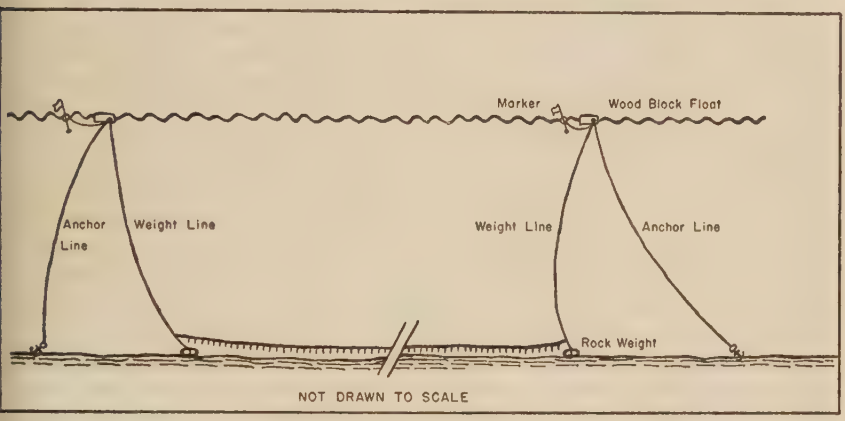

Figure 16. Method of setting line to be "under run" without resetting the anchors

Under Running

For much of the deep water fishing the Newport men followed the conventional method of setting lines, that is, without weights other than an anchor at each end of a string with buoy line and flag marker. (Fig. 11.) For moderate depths when lines were left set for long periods but ifted frequently for rebaiting, a more convenient method of setting was ollowed by Newport and San Diego fishermen. In this method the end of a string was weighted and could be brought to the surface without disturbing the anchor. This necessitated a weight-line to the buoy in ddition to the separate anchor-line. (Fig. 16.) Lifting the line for aiting without moving the anchor was called locally "under running."

Bait

Mackerel was the bait preferred for sharks, although kingfish were sed when mackerel were scarce. A freshly caught shark of an inferior species ("junk shark") was often cut up for bait. Fishermen agreed hat iced bait was better than salted. For halibut the bait was usually anchovies, sardines, cut squid or cut mackerel.

Skiff Fishing

Newport has been unique in that skiff fishermen for years have conducted an open air fresh fish market on the beach, selling their own catch direct to the public from the skiff drawn up on the sand. Many of these men turned to shark set lining especially during the war years when the public was not driving cars to resort beaches. The skiffs were

provided with outboard motors but lines had to be pulled by hand. The fisherman usually worked alone and necessarily handled a limited amount of set line gear. There was such variation in the construction of the gear that no two men had similar equipment.

Currents

In the Newport-San Diego area bad currents are the exception and seas are much calmer than north of Point Conception. Lines were set parallel with the coast to avoid fouling passing craft but where a current was noticeable the set was made with the current. When present currents are frequently down the coast so that some fishermen set at a diagonal to the beach. Calm seas permit lighter anchors and smaller floats. Wooden buoys were often used, such as a 6 x 6 x 20 inch piece of painted redwood. Two- and three-gallon kegs were common and some men used cork buoys with a flag marker. Every variety of anchor was to be seen even to a five-pound rock or piece of scrap iron. Three- to four-pound five-pronged grapnels were used most and occasionally a fisherman purchased mushroom anchors. One of the leaders among the fishermen used, in addition to anchors, lead sinkers of 1½ pounds weight on his main line, one or two such sinkers to each 100 hooks when fishing for hammerhead or soupfin sharks. He found also, that setting his line slack allowed large sharks more play and they were less apt to cut leaders and ground line. It was common practice to use about 80 fms of anchor line in water of 40 to 60 fm.

Main Lines

On boats provided with a gurdy, most shark lines were of light manila rope about equally divided between $\frac{1}{4}$ and $\frac{3}{16}$ inch diameter. Skiff fishermen pulling by hand often preferred cotton line of 210-thread medium laid. One prominent skiff fisherman used 72-thread medium laid. Several men used lines 2,500 to 3,000 feet long (500 fm.). One skiff fisherman setting for small sharks used 2,340 feet of line made up from four skeins of 72-thread twine.

Gangen Spacing

Heavy gear for large sharks was made up with gangens 6 to 12 feet long, 8 and 10 feet being the normal length. Standard gangens were made up from $\frac{3}{16}$ inch diameter manila rope and spacing was 25 to 30 feet apart. Lighter gear for small sharks and halibut used leaders two feet long spaced 5½ feet apart. Most of the shark gear was made with 100 hooks to the piece of main line. A few lines carried 75 hooks and some shorter lines were made up with 50 hooks for setting on rock bottom. Hook sizes were No. 12/0, 15/0 and 16/0 for sharks. No. 3/0 and 5/0 hooks were used for halibut.

Amount of Gear

Fishermen working alone often set only one or two pieces of line (100 to 200 hooks). Two-man boats sometimes set seven lines but the average at Newport was three lines (300 hooks) per man.

SHARK SET LINING AT EUREKA

Lines Versus Nets

As elsewhere in the State, when the value of shark liver vitamins became generally known in 1936 or 1937 the set liners of Eureka (Humboldt County) turned to shark fishing. The fishery was the chief source of supply supplemented by the sharks caught incidentally by the trawlers who were after flatfish primarily. Beginning in 1939 there was an influx into California of Seattle halibut boats with their heavy halibut lines which they tried out on California sharks and soon the gear was modified for shark fishing. This partial monopoly by local and Seattle long liners lasted only a couple of seasons when in 1941 the field was invaded by gill netters fishing for sharks in waters less than 18 to 20 fm. In deeper water gill net corks waterlogged and nets collapsed. Late in 1942 the introduction of glass ball floats enabled gill nets to fish in deep water.

The following account of set lining at Eureka is derived largely from notes made in November, 1941, at which time some 50 boats were shark fishing at Eureka, about one-half of which were gill netters and half were set liners. At that time gill nets still were limited to waters less than 20 fm. In late 1941 the gill nets had demonstrated their effectiveness and were getting the lion's share of the shark catch, so that the more opulent fishermen were supplying themselves with nets. A few weeks later, after events at Pearl Harbor, they found difficulty in obtaining webbing. In November, 1941, the outlay of several thousand dollars for nets was the chief deterrent to would-be gill netters. By contrast, set lines were very cheap. At this time a good many former halibut fishermen from Seattle were still coming to Eureka and the shark "gold rush" was on with high liver prices and large catches.

Depth and Area Fished

At Eureka in 1941 set lines were fishing sharks in waters of 15 to 110 fm. whereas gill nets were confined to depths of 18 to 20 fm. Most of the Eureka boats fished within 30 or 40 miles of port but several of the former halibut boats took chipped ice in the hold on trips of 6 to 10 days, during which they ranged the whole north coast of California and into southern Oregon. Small boats in good weather often took ice for two- or three-day trips but through the winter season the seas were too rough for more than one-day trips by small craft.

Halibut Versus Local Boats

Two types of boats were operating at Eureka in 1941. Several larger boats from Seattle with crews of four or five men naturally retained many of their halibut fishing habits and so favored long trips, very long lines, and an abundance of gear. By contrast, the local small boats with one and two men out for one day favored lighter gear and less of it.

Halibut Boat Gear

Typical of the halibut boats fishing sharks at Eureka was one that commonly made trips of five to 10 days and took six tons of ice and three tons of bait each trip. The fisherman was using tubs for his lines

but still referred to his gear as skates. These lines were 250 to 300 fm. to the tub and carried 114 to 120 hooks per tub. Leaders were 3½ feet long and were spaced 13 feet apart. He set three to seven "skates" to a string and set two or three strings so had on board ready for use 15 to 20 tubs of line.

Small Boat Gear

Although there was much variation in the small boat gear, it consistently was lighter and more limited in amount than the gear of the large boats. Most of the small boat lines ran 160 to 225 fm. to the tub and carried 80 to 85 hooks. Gangens were three to five feet long and varied in spacing 9, 12, 16, or 18 feet apart. Local boats carried six to 12 tubs of line but usually set only two to five tubs to a string and quite commonly laid out only one string. On calm days two strings might be shot. Neither large nor small boats could "soak" their lines more than two hours without attacks by hagfish so the common practice was to pick up in one or two hours.

Bait

Bait for sharks was mostly small soles obtained from the trawlers or trucked up from San Francisco frozen in blocks of ice. Sardines and salmon heads were used also.

At Fort Bragg

In November of 1941 about 25 boats were shark fishing at Noyo (Fort Bragg). Three of these were equipped with gill nets and others fishermen expected to replace their lines with nets as soon as possible. Fishing was between Punta Gorda and Shelter Cove but good catches were made in the neighborhood of Point Arena. Boat trips were from one to three days but small boats stayed within 10 miles of port. Much of the set lining was 10 to 15 miles off shore but generally in 30 to 100 fm. One representative fisherman used 240 to 270 fm. of line per tub, 80 to 90 hooks per tub on gangens 18 feet apart (3 fm.). Another fisherman used similar gear with 250 fm. lines, 60 to 80 hooks per tub on four-foot gangens three to four fm. apart. About eight tubs of gear was the standard amount shot at any one time.

SHARK SET LINING AT MONTEREY AND SAN FRANCISCO

Byers (1940) describes set lines as used for sharks at Monterey in the summer of 1939. A ¼-inch diameter manila rope was used for ground line with three-foot 72-thread hard laid cotton leaders spaced 12 to 13 feet apart. Hook size was 11/0 and each piece of main line (about 150 fm.) carried an average of 70 hooks. Sardines, mackerel, anchovies, and herring were used for bait. Boats cruised the coast from Port San Luis (San Luis Obispo County) to Half Moon Bay (San Mateo County).

At San Francisco two types of set lines were fished for sharks in 1939. The rockfish set liners used, for small sharks, much the same kind of gear they had been accustomed to using. The ground line was 216-thread with 33-thread hard laid gangens three feet long and three feet

part carrying size 9/0 hooks. Each line (100 fm.) carried 200 hooks. he usual crew was two men handling eight baskets of line.

More specialized gear was used for larger sharks at San Francisco. his gear used 72-thread gangens three feet long but spaced 12 feet part with size 11/0 to 14/0 hooks and 70 hooks per line. Main lines ere therefore about 140 fm. long and two men to a boat fished 10 skets of line. Much of the shark set lining was inside San Francisco ay under permit but trips were made outside to the Farollone Islands nd down the coast to Half Moon Bay. Lines were set in 10 to 100 fm. water.

SHARK SET LINES AT AVILA AND HUENEME

In November, 1941, all the Avila (San Luis Obispo County) fisher- en in their small boats were out after sharks and there was no one to pply the local fresh fish market. About 20 boats were set lining, using 0 hooks per boat on the average. One boat fished 920 hooks but this as exceptional. The four-foot gangens were spaced five fm. apart. The ats fished up to 2000 fm. of line and averaged about 1½ miles of ound line.

On December 2, 1941, only a few days before there was need to ar hostile submarines, there were 10 boats fishing sharks at Hueneme Ventura County). At that time there were no gill nets operating though net boats previously had made shark deliveries at the port. ines were 150 to 160 fm. per piece. Gangens were $\frac{3}{16}$-inch diameter anila rope (referred to as "6 thread fine"), five feet long and spaced to 22 feet apart. Hook sizes were from No. 12/0 to 16/0 and 50 hooks r piece of line was customary. One man used only one piece to a set t laid out three different pieces. Another fisherman in a 22-foot boat ed one piece of line less than 100 fm. long with 65 hooks nine feet part but four of the hooks were extra large in the hope of catching black a-bass (jewfish). It was the accepted procedure for Avila and Hueneme hermen to run a small set line especially for mackerel to be used as it for their shark set lining.

SHARK SET LINES IN MEXICO

While the vitamin bonanza was on, a fleet of Southern California ats fished sharks in Mexico and shipped the livers to California in liver cans" which are five-gallon cans with a circular friction lid set the square top. Vitamin potency of livers from Mexico was not very gh and as vitamin prices sagged the number of boats fishing sharks in e far south dropped to a scattered few. By the summer of 1946 only occasional boat was equipped for Mexican shark fishing.

The set line gear used for large sharks in the far south was much avier than the lines used in California, as illustrated by the equipment one typical boat (July, 1946). The main line was a $\frac{5}{8}$-inch manila pe with leaders which were spliced into the main line. Leaders were inch manila rope spaced three fm. apart, each leader being only three et long but at the far end each carried a 1½-foot piece of chain above e hook to protect the leader against the sharp teeth of the sharks. is chain was swiveled to the manila leader. The hook size was usually

No. 20/0 with some No. 18/0 hooks. The three fm. spacing of leaders permitted only 40 hooks to each piece of main line and the heavy manila rope more than filled an ordinary set line tub so that the gear was coiled down in oversized tubs.

MACKEREL SET LINES

Although long lining for mackerel in the past was chiefly by drift line, there are a few fishermen scattered along the coast of Southern California who operate set lines for mackerel. These men usually work alone from small boats and are satisfied with modest catches that can be sold in local markets. Typical of this group is a former Newport set liner now (1945) fishing out of Santa Barbara. It is possible that the moderate currents of the Santa Barbara area would permit of drift lines inasmuch as the lines are worked continuously anyway but no doubt the lifetime habits of set lining persist. At any rate, this Santa Barbara fisherman, from his small boat, anchors his one tray of line, works it constantly and pulls by hand. His trips are from early morning to mid-afternoon and are never very far from port. Knowing the habits of mackerel, the fishing is done close to shore in waters 18 to 25 fm. deep but the line is set 15 to 30 feet (2½ to 5 fm.) under the surface. The line is set in the usual manner with a five-pound anchor, keg buoy and flag at each end. The line is light, being 72-thread cotton, 100 fm. long and carrying about 120 No. 6/0 hooks spaced five feet apart. Gangens are 18 inches long of 21- or 24-thread twine. Cut mackerel is the best bait but anchovies are sometimes used.

Apart from the set lining of mackerel for local markets, there were in the heyday of shark fishing, a good many long liners who operated a small amount of set line to catch mackerel to be used as bait in their fishing for sharks.

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